

CLAIMS

2 What Is Claimed Is:

1. An illumination source comprising:
 - 4 a first monochromatic illumination source comprising an associated illumination center-wavelength and associated illumination tolerance, wherein the source emits rays defining an illumination path; and
 - 6 a bandpass filter positioned in the illumination path, wherein the filter comprises an associated filter center-wavelength and an associated filter tolerance, and wherein
 - 10 the filter tolerance is no greater than approximately one-half the illumination tolerance and
 - 12 the filter center-wavelength is approximately within a range from about the illumination center-wavelength minus the illumination tolerance to about the illumination center-wavelength plus the illumination tolerance.
- 16 2. The illumination source of Claim 1, wherein:
 - the monochromatic illumination source is an LED;
 - 18 the illumination center-wavelength is approximately 700nm; and
 - the illumination tolerance is no greater than about 20nm.
- 20 3. The illumination source of Claim 2, comprising:
 - 22 a second illumination source emitting rays defining another illumination path reflecting off of the filter in a first direction, wherein the first illumination source and second illumination source are arranged relative to the filter such that rays from the first illumination source pass through the filter in the first direction, whereby the first and second illumination sources provide coaxial illumination.
- 28 4. The illumination source of Claim 3, wherein the second illumination source is an LED comprising an associated center-wavelength of approximately 940nm.

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5. The illumination source of Claim 3, wherein the illumination path
2 associated with the second illumination source is positioned roughly 90 degrees
relative to the illumination path associated with the first illumination source.

6. The illumination source of Claim 1, comprising a second illumination
6 source emitting rays defining another illumination path reflecting off of the filter in a
first direction, wherein:

8 the first illumination source is an LED and the associated illumination
center-wavelength is approximately within a range from about 680nm to about
10 960nm;

12 the second illumination source is an LED comprising an associated
illumination center-wavelength approximately within a range from about 510nm to
740nm; and

14 the first illumination source and the second illumination source are
arranged relative to the filter such that rays from the first illumination source pass
16 through the filter in the first direction.

18 7. The illumination source of Claim 6, wherein:

20 the illumination center-wavelength associated with the first
illumination source is approximately within a range from about 700nm to about
740nm; and

22 the illumination center-wavelength associated with the second
illumination source is approximately within a range from about 510nm to about
24 550nm.

26 8. The illumination source of Claim 7, wherein the illumination tolerance
is not greater than about 20nm

9. A readhead comprising:

a first LED having a first center-wavelength associated therewith and being adapted to emit a first path of light;

a second LED having a second center-wavelength associated therewith and being adapted to emit a second path of light intersecting the first path of light at an intersection;

a beam splitter positioned at the intersection and having a bandpass filter associated therewith, wherein:

the first LED, the second LED and the beam splitter are arranged to provide coaxial illumination in a first direction,

the bandpass filter comprises a relatively narrow bandpass compared to a bandwidth associated with the first LED,

at least a portion of the coaxial illumination is reflected off a sample creating diffuse reflected light; and

the readhead further comprises a detector located to receive at least a portion of the diffuse reflected light.

10. The readhead of Claim 9, wherein:

the bandwidth associated with the first LED is approximately 100nm;

and

the narrow bandpass is approximately 25nm.

11. The readhead of Claim 9, wherein the first and second LEDs have associated tolerances not greater than 20nm and the bandpass filter has an associated tolerance of not greater than 10nm.

12. The readhead of Claim 9, comprising a light-scattering section upstream of the detector, wherein the light-scattering section comprises plurality of steps formed at predefined angles greater than 90 degrees.

13. The readhead of Claim 12, wherein the predefined angles at which the steps are formed are not less than approximately 100 degrees.

2 14. A readhead adapted for use in a monitoring system adapted to receive a
sample on a sample aperture and determine a parameter value based on analyzing the
4 sample, the readhead comprising:

 a first LED having a first center-wavelength and a first tolerance
6 associated therewith and being adapted to emit a first path of light;

 a beam splitter comprising a bandpass filter positioned in the first path
8 of light and having a filter center-wavelength and a filter tolerance associated
therewith;

10 a second LED positioned relative to the first LED and the beam splitter
and having a second center-wavelength and a second tolerance associated therewith
12 and being adapted to emit a second path of light intersecting the beam splitter,
wherein:

14 the second LED, the beam splitter and first LED are positioned
to provide coaxial illumination of the sample by the first and second LEDs,

16 the filter tolerance is less than the first tolerance,

 the bandpass filter comprises a relatively narrow bandpass
18 compared to a bandwidth associated with the first LED; and
the readhead further comprises:

20 a face defining an exit aperture through which the coaxial illumination
passes, wherein the sample aperture is spaced a predetermined distance from the face
22 and positioned to be illuminated by the coaxial illumination, such that when the
sample is located on the sample aperture, the sample will reflect at least a portion of
24 the coaxial illumination; and

 a detector adapted to detect diffuse light resulting from the reflected
26 illumination.

28 15. The readhead of Claim 14, wherein the filter tolerance is less than the
second tolerance.

30 16. The readhead of Claim 14, wherein the bandwidth of the first LED is
32 approximately 100nm and the filter bandpass is approximately 25nm.

2 17. The readhead of Claim 14, wherein at least light from the first LED is
filtered by the filter.

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 18. The readhead of Claim 15, wherein light from the second LED is
6 reflected off the filter to provide the coaxial illumination with light from the first LED
passing through the filter.

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 19. The readhead of Claim 14, wherein the second center wavelength is
10 higher than the filter center-wavelength and the first center-wavelength.

12 20. The readhead of Claim 19, wherein the filter tolerance is less than the
second tolerance.

14
 21. The readhead of Claim 20, wherein the filter tolerance is not greater
16 than about 10nm.

18 22. The readhead of Claim 21, wherein the first center-wavelength is about
700nm and the second center-wavelength is about 940nm.

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 23. The readhead of Claim 14, comprising a light-scattering section
22 associated with the detector, wherein the light-scattering section comprises a plurality
of steps defining one or more angles greater than 90 degrees and positioned to reduce
24 internal stray light reaching an active area of the detector.

24. A readhead adapted for use in a monitoring system adapted to receive a sample on a sample aperture and determine a parameter value based on analyzing the sample, the readhead comprising:

a first LED having a first center-wavelength associated therewith and being adapted to emit a first path of light;

a beam splitter positioned in the first path of light;

a second LED positioned relative to the first LED and the beam splitter and having a second center-wavelength associated therewith and being adapted to emit a second path of light intersecting the beam splitter, wherein

the first and second paths of light interact with the beam splitter forming a beam of illumination comprising light from the first LED and the second LED; and the readhead further comprises

a face defining an exit aperture through which the beam passes, wherein the sample aperture is spaced from the face and positioned to be illuminated by the beam such that when the sample is located on the sample aperture, the sample will reflect at least a portion of the beam;

a detector comprising an active area and a detection aperture positioned to receive at least a portion of diffuse light resulting from the reflected beam; and

a light-scattering section positioned upstream of the detector active area, wherein the light-scattering section comprises a plurality of steps defining one or more angles greater than 90 degrees and the section is positioned such that the steps are angled to reduce stray internal light on the detector active area.

25. The readhead of Claim 24, wherein the one or more angles defined by the plurality of steps are approximately 100 degrees.

26. The readhead of Claim 24, wherein the second center-wavelength is greater than the first center-wavelength.

27. The readhead of Claim 26, wherein:

2 the beam splitter comprises a bandpass filter having a filter center-wavelength and a filter tolerance associated therewith; and

4 the filter center-wavelength and filter tolerance are selected to separate wavelength associated with the first LED from wavelengths associated with second
6 LED such that the light in the beam from the first LED does not have wavelengths equal to wavelengths of light in the beam from the second LED.

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28. The readhead of Claim 26, wherein:

10 the first LED has associated therewith a first bandwidth and a first tolerance;

12 the second LED has associated therewith a second bandwidth and a second tolerance;

14 the beam splitter comprises a filter; and
the filter has associated therewith a filter bandpass being relatively
16 narrow compared to the first bandwidth and the second bandwidth.

18 29. The readhead of Claim 28, wherein the filter has associated therewith a filter center-wavelength less than approximately the second center-wavelength plus
20 second tolerance.

22 30. The readhead of Claim 29, wherein the filter center-wavelength is less than approximately the first center-wavelength plus the first tolerance.

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31. The readhead of Claim 30, wherein the filter center-wavelength is less than approximately the first center-wavelength minus the first tolerance.

28 32. The readhead of Claim 30, wherein the filter center-wavelength is less than approximately the first center-wavelength minus 20nm.

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33. The readhead of Claim 32, wherein the filter has associated therewith a
32 tolerance less than approximately 20nm.